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Subject: Final Technical Report for Cooperative Agreement No. NCC2-115, between NASA Ames Research Center and the University of California at San Francisco, entitled: "Psychophysiological Investigations of the Biomedical Problems of Manned Spaceflight". Period of Performance: January 1, 1990 to February 28, 1993.

This report summarizes the accomplishments made as a result of the research collaboration supported by the above Cooperative Agreement. We have addressed each of the projects as outlined in the original proposal's table of contents, section IV. Projected Research. Attachments include published papers, NASA Technical Memorandum; papers in press and abstracts of papers accepted for presentation at National and International research meetings.

### Projected Research

#### Part A: Laboratory Investigations: Ground Based Research

##### Project 1. Statistical Analyses of Human Autonomic Data.

This work was funded in part by the RTOP: Extended Data Analyses: 199-70-12-14, entitled: A Database of Human Psychophysiological Responses.

a. Objectives: (1) To establish a relational data base containing human psychophysiological data obtained from Shuttle flight experiments and ground-based research over a 20 year period. (2) Enable multi-user access and retrieval of these data for subsequent analyses and for possible inclusion in the proposed Life Sciences Data Archive. (3) Enable/conduct statistical analyses across several experiments on large subject populations which can thereby provide definitive answers to questions on human autonomic and behavioral responses and adaptation to environmental stressors on Earth and in space.

b. Accomplishments: (1) Installed Ingress relational database management system. (2) Initiated installation of ground-based data into Ingress; (3) Installed 500 hours of human biomedical data obtained in micro-g (Spacelab-3 and Spacelab-J); (4) initiated statistical analyses of flight data, (time series, spectral and coherence analyses of heart and respiration rates; etc.); (5) Completed installation of local network for PC's, Macintoshes, Sun Work Station and mainframe; (6) purchased optical scanner for input of meta-data into the database.

(NASA-CR-194107)  
PSYCHOPHYSIOLOGICAL INVESTIGATIONS  
OF THE BIOMEDICAL PROBLEMS OF  
MANNED SPACEFLIGHT Final Technical  
Report, 1 Jan. 1990 - 28 Feb. 1993  
(California Univ.) 4 p

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3 PAGESc. Publications/Reports/Abstracts Enclosed:

Cowings, P.S., Naifeh, K.H. and Toscano, W.B. (1990) The stability of individual patterns of autonomic responses to motion sickness stimulation. Aviation Space and Environmental Medicine, 61, (5), 399-405.

Cowings, P.S. (1990). Autogenic-Feedback Training: A Preventive Method for Motion and Space Sickness. In: (G. Crampton (ed.)). Motion and Space Sickness. Boca Raton Florida: CRC Press. Chapter 17, Pp.354-372.

Stout, C & P. Cowings (1993). Increasing Accuracy in the Assessment of Motion Sickness: A Construct Methodology, NASA Tech. Memo in progress, paper to be submitted to Psychological Reviews.

Stout, C., Toscano, W.B. & Cowings, P.S. (1993). The Assessment of Motion Sickness Symptoms and Autonomic Responses: Single Subject Design. NASA Tech. Memo in progress, paper to be submitted to Aviation Space & Environ. Med.

**Project 2: Research on Motion Sickness.**

This work as funded by the Flight Projects Office and was conducted in support of Spacelab-J. Note: The study described in the paper by Kellar et al. was not funded, but was conducted as a no-cost exploratory collaboration. The NASA and University collaborators provided U.S. Army and Coast-Guard investigators with information on AFT procedures, experimental design, data analysis, and participated in the preparation of this publication.

a. Objectives: (1) To test/ develop hardware and procedures to be incorporated into preflight training of crewmembers of Spacelab-J. (2) To examine "spin-off" applications of AFT.

b. Accomplishments: (1) AFS-2 flight hardware met all investigator specifications for signal quality, ease of operation, and crew acceptance. (2) preflight and inflight procedures were developed and documented.

c. Publications/Reports/Abstracts Enclosed:

Toscano, W.B. and Cowings, P.S. (1990) The Effect of Training Schedule on Learned Suppression of Motion Sickness Symptoms Using Autogenic-Feedback Training. Paper presented at the Annual Meeting of the Aerospace Medicine Association, New Orleans.

Kellar, M.A., Folen, R.A., Cowings, P.S., Toscano, W.B. & Hisert, G.L. (1993) Autogenic-Feedback Training Improves Pilot Performance During Emergency Flying Conditions. NASA Technical Memorandum #104005. NASA-Ames Research Center, Moffett Field, Ca.. March.

Cowings, P.S., Toscano, W.B. & Reynoso, S. (1993) The Use of Autogenic-Feedback Training as a Treatment for Air-Sickness in High Performance Military Aircraft: Two Case Studies. NASA Tech. Memo in progress, paper to be submitted to Aviation Space & Environ. Med.

### **Project 3: Research on Orthostatic Intolerance.**

The studies outlined in this section were submitted to the Space Physiology and Countermeasures RTOP but were not funded. A modified version of this work will be re-reviewed in August of this year. This work was funded in part by Director's Discretionary Funding.

a. Objectives: (1) To test the feasibility of applying Autogenic-Feedback Training as a potential treatment for postflight orthostatic intolerance.

b. Accomplishments: (1) Built prototype computer-controlled blood pressure tracking system, (2) Successfully trained Spacelab-J crewmembers (prime and alternates) to voluntarily increase their own blood pressure in the presence of a gravitational stimulus.

c. Publications/Reports/Abstracts Enclosed:

Cowings, P.S., Toscano, W.B., Kamiya, J., Miller, N.E., Pickering, T. and Shapiro, D. (1990). Autogenic-Feedback Training as a Countermeasure for Orthostatic Intolerance. Proceedings of the First Joint NASA Cardiopulmonary Workshop - Houston, TX. NASA Conference Publication #10068.

### **PART B. Shuttle Flight Experiment**

#### **Title: Autogenic Feedback Training as a Preventive Method for Space Motion Sickness.**

a. Objectives: (1) To evaluate the effectiveness of Autogenic-Feedback Training as a countermeasure for space motion sickness. (2) To compare physiological data and inflight symptom reports to ground-based motion sickness data. (3) To predict susceptibility to space motion sickness based on preflight data of each treatment group crewmember.

b. Accomplishments: This experiment (AFTE) was successfully conducted on Spacelab-J, launched September, 1992. Aboard were two mission specialists who supported this investigation, (one who received AFT and one who served as a no-treatment control subject). Also aboard was a Japanese Payload Specialist who served as an operational test-subject (did not have access to AFTE flight hardware). All objectives were met.

c. Publications/Reports/Abstracts Enclosed:

Cowings, P.S., Toscano, W.B. (1993). Autogenic-Feedback Training (AFT) as a Preventive Method For Space Motion Sickness: Background and Experimental Design. NASA Tech. Memo in progress, paper to be submitted to Aviation Space & Environ. Med.

Cowings, P.S. (1993) .Psychophysiology of Humans in Space. A Symposium Summary: Submitted for presentation at the 33rd Annual Meeting of the Society for Psychophysiological Research

Cowings, P.S., Toscano, W.B., Miller, N.E. (1993) A Behavioral Medicine Approach to Facilitating Adaptation to Space: Autogenic-Feedback Training. Submitted for symposium presentation at the 33rd Annual Meeting of the Society for Psychophysiological Research. NASA Tech Memorandum in progress. Paper to

be submitted to Psychophysiology.

Cowings, P.S., Toscano, W.B., & Miller, N.E. (1993) A Behavioral Medicine Alternative: Autogenic Feedback Training as a Treatment for Motion and Space Motion Sickness; paper to be submitted to Biofeedback and Self-Regulation.

Cowings, P.S., Toscano, W.B.; Sekiguchi, C. & Ishii, M. (1993). Preflight AFT for control of space motion sickness: SPACELAB-J.; Paper accepted for presentation at 64th annual meeting of Aerospace Medical Assoc., Toronto, Canada. NASA Tech. Memo in progress, paper to be submitted to Aviation Space & Environ. Med.

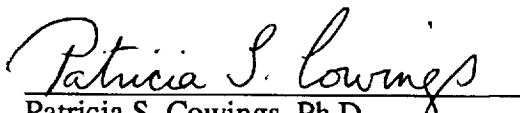
Cowings, P.S., Toscano, W.B., Miller, N.E., Stout, C, Reynoso, S. (1993) The effects of promethazine on: Psychological responses, performance and susceptibility to motion sickness. Submitted for symposium presentation at the 33rd Annual Meeting of the Society for Psychophysiological Research. NASA Tech Memorandum in progress. Paper to be submitted to Psychophysiology.

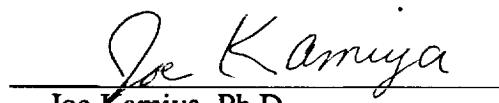
Eodice, M.T., Cowings, P.S. & Toscano, W.B. (1993). A Lightweight, Ambulatory Bio-Instrumentation System for Aerospace Applications. Preprint submitted to IEEE

Toscano, W.B., Cowings, P.S. (1993) Heart rate variability of humans in space; Paper accepted for presentation at 64th annual meeting of Aerospace Medical Assoc., Toronto, Canada. NASA Tech. Memo in progress, paper to be submitted to Aviation Space & Environ. Med.

Toscano, W.B., Cowings, P.S. & Miller, N.E. (1993). Monitoring Astronauts' Functional State: Autonomic Responses to Microgravity. Submitted for symposium presentation at the 33rd Annual Meeting of the Society for Psychophysiological Research. NASA Tech Memorandum in progress. Paper to be submitted to Psychophysiology.

We trust this fulfills your requirements for a final technical report. If you require any additional information, please feel free to contact us.

  
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